TECHNICAL SPECIFICATIONS FOR CROSS LINKED POLYETHYLENE INSULATED 3 CORE 11KV CABLES

1.00.00 **SCOPE:**

1.01.00 The scope of this package, covers the design, manufacture, stage inspection at works, inspection and testing of finished cables at manufacture's works, testing at independent test house, packing, transport and delivery to consignee's address of 6.35/11KV Three Core, aluminium conductor, XLPE insulated, screened, under ground Cables as per specified construction.

1.02.00 Technical Requirement: Three Core 6.35/11KV grade, 90°C rating heavy duty power cable with stranded compacted circular aluminium conductor shielded with extruded semi conducting compound, cross linked polyethylene insulated, shielded with extruded semi conducting compound and copper tape, shielded cores laid up with fillers, inner sheath of extruded PVC, Galvanized round steel wire Armour and PVC ST-2 overall sheath.

1.03.00 The cables should be suitable for use in solidly earthed system.

1.04.00 The Stranded Aluminium Conductor for different sizes of cable shall have the short circuit rating specified in this document, in schedule of requirement, schedule-I, Annexure TS-1.

2.00.00 **STANDARDS:**

2.01.00 The 11KV UG Cables shall, in general, meet the requirements of the latest edition of the Bureau of Indian Standards, (generally referred as IS) IS 7098 (Part-2) 1985. The cables manufactured to and meeting the testing requirements of international standards, like B.S.S. IEC or equivalent standards are also acceptable. The bidders shall enclose a copy of the equivalent international standard, in English Language, along with the Bid.

The extracts from IS 7098 (Part 2) are given in Annexure TS-3.

The cables and components in general shall meet the requirement Indian Standards with latest amendments or equivalent International Standards.

IS: 7098 (Part 2)	1985 :	Specification for cross linked polyethylene insulated PVC sheathed cables
IS: 8130	1984 :	Specification for conductors for insulated Electric Cables

IS: 3975	1979 :	Specification for mild steel wires, strips and tapes for armouring of cables.
IS: 10810 (Part 1 to 55)	1984 :	Specification for test on cables
IS: 5831	1984 :	Specification for PVC insulation and sheath of electric cables
IS: 10418	1982 :	Specification for drums for electric cables
IS: 10462 (Part-I)	1983 :	Fictitious calculation method for determination of dimensions of protective covering of cables: Part-I Elastomeric and thermoplastic insulated cables.

2.02.00 11KV underground cables shall be manufactured to the highest quality, best workmanship with scientific material management and quality control. The Bidder shall furnish the quality plan, giving in details the quality control procedures/management system.

The successful bidder shall give sufficient advance notice to the purchaser of not less than fifteen days to arrange for stage inspection and inspection of quality assurance programme during manufacture, at the works.

3.00.00 **SYSTEMS DETAILS:**

General Technical Particulars:

1) Nominal System Voltage (rms) (u)	-	11 KV
2) Highest System Voltage (rms) (um)	-	12 KV
3) Phase to Earth Voltage (uo)	-	6.35 KV
4) Number of Phases (for 3 core cables)	-	3
5) Frequency	-	50 Hz
6) Variation in frequency	-	±3%
7) Type of Earthing	-	Solidly Earthed
8) Basic impulse level (1.2/50 Micro Second Wave	-	75 KV
9) Total relay & circuit break operating time	-	15-20 Cycles
10) One minute power frequency withstand voltage	-	28 KV

4.00.00 **INSTALLATION CONDITIONS**:

a) Mostly directly buried in ground, partly in RCC/Hume pipes or stoneware pipes at road crossing in case of 3 core cables.

b) If more than one circuit is laid in the same trench, then laid in flat formation for 3 core cables.

c) Metallic coverings are connected solidly to earth at both ends of the run for 3 core cables and.

d) Normal depth of laying is 900 mm to 1000 mm (from top of round to entre of cable).

e) Nature of soil – Heterogeneous, sandy.

f) Soil resistivity: variable 18 to 100 Ohm – meter

g) Soil Thermal resistivity (assumed) 120 to 150 dig. C. Cm/w.

5.00.00 **CLIMATIC CONDITIONS**:

The climatic conditions at Bangalore City where these 11KV Cables will be installed are as under:

1	Location	Karnataka (28.58 N, 77.38E)
2	Altitude	1000 M above MSL
3	Max. ambient air temperature	45^0 C
4	Max. daily average air temp.	38^0 C
5	Minimum ambient air temp.	10^0 C
6	Ground temperature at depth of laying assumed	35^0 C (Max.)
7	Isoceranic level	5^0 C (Min.)
8	Avg. annual rainfall	As per IS:45
9	Avg. number of rainy	1450 Sq.mm.
10	Climatc	Tropical Moderately hot and humid
11	Soil	Normally dry. As per IS:1200 Part-I, 1974, likely hood of subsoil water at certain location at depth of burial of cables.

6.00.00 **DESIGN CRITERIA**:

6.01.00 The cables that are covered in these specifications are intended for use in the Karnataka Power distribution system, under the climatic conditions and installation conditions descried in the technical specification.

6.02.00 Any technical feature, not specifically mentioned here, but is necessary, for the good performance of the product, shall be incorporated in the design. Such features shall be clearly brought out under Technical deviations schedule only in the offer made by the Bidder, giving tcchnical rcasons, and justifying the need to incorporate these features.

6.03.00 For continuous operation of the cables, at specified drawing, the maximum conductor temperature shall be limited to the permissible valuc as per the relevant standard, generally not exceeding 90^0C under normal operation and 250^0C under short-circuit conditions.

6.04.00 The cables in service will be subject to daily load cycles, of two peaks during day, morning peak and evening peak with reduced loading during the nights.

6.05.00 The materials used for sheaths shall be resistant to oils, acids and alkalies.

6.06.00 The cables shall be designed to withstand the thermo mechanical forces and electrical stresses during normal operation and transient conditions.

The Cables shall be designed to have a minimum useful life span of forty years.

Core identification: The core identification for 3 core cables shall be provided, by suitable means, like, by application of coloured stripes, or by numerals or by printing on the cores as per clause 13 of IS:7093.

7.00.00 **MANUFACTURE PROCESS, CROSS LINKING OF INSULATION:**

7.01.00 Cross linking of the insulation materials (pre compounded polyethylene) shall be conforming to IS:7098 (Part-II).

7.02.00 The conductor screen shall be of extruded semi conducting compound. The insulation screen shall consist of the nonmetallic part extruded semi conducting compound with non magnetic metallic port. The XLPE insulation and the shields for conductor and insulation shall be extended in one operation.

8.00.00 **MATERIALS:**

8.01.00 CONDUCTOR: The conductor shall be of stranded construction. The material for conductor shall consist of plain aluminium of H2 or H4 grade as per clause-3 of IS:8130/1984.

The number of wires in the conductor shall be not less than the appropriate minimum number given in Table-2 of IS:8130/1984.

8.02.00 INSULATION: The insulation shall be cross linked polyethylene conforming to the requirements given in Table-1 of IS:7098 Part-II.

8.03.00 SCREENING: The screening shall consist of semi conducting compound. The metallic screen for core shall consist of copper tape. The metallic screen with Armour shall be designed to carry the minimum short circuit rating for 1 second. (The design calculations shall be furnished by the tenderer).

8.03.01 The semi-conducting compound shall withstand the operating temperature of the cable and shall be compatible with the insulting materials.

8.04.00 **Filler and inner sheath for Multi Core Cables:**

For Multi Core cables, the interstices at the centre shall be filled with a non-hygroscopic materials.
The interstices around the laid up cores shall be covered with PVC compound type S.T-2. This will form the inner sheath for Multi Cores Cables.

8.05.00 **ARMOURING FOR 3 CORE CABLES:**

The armour shall be galvanized round steel wire, complying with the requirements of IS:3975. The Single Core Cables shall be armoured with hard drawing Aluminium round wire. A binder tape may be applied on the armour.

8.06.00 **OUTER SHEATH**:

The outer sheath shall consist of Poly Vinyl Chloride (PVC) compound, confirming to the requirements of Type ST-2 of IS:5831 suitable additive shall be added to give anti termite protection.

9.00.00 **CONSTRUCTION:**

The general constructional features of the cables shall be as follows:

a) **3 Core Cables**: Stranded, Compacted, Circular, Aluminium Conductor, Conductor Screen of extruded semi conducting compound, Cross linked polyethylene insulation, cross linked, shall be conforming to IS:7098 (Part-II).

Insulation screen consisting of non-metallic part of extruded semi conducting compound and the metallic part of copper tape(s).

Pressure Extruded PVC inner sheath
Armour (Galvanised Steel round wire)
Other PVC sheath with anti-termite treatment.

10.00.00 **CONDUCTOR:**

10.01.01 The conductor shall be stranded, compact, circular of aluminium wires of H2 or H4 grade plain aluminium wires.

10.01.02 The conductor shall be clean, uniform in size and shape smooth and free from harmful defects.

10.01.03 Not more than two joints shall be allowed in any one of the single wire forming every complete length of conductor and no joint shall be within 300 mm of any other joint in the same layer. The joint shall be made by brazing, silver soldering or electric or gas welding.

10.01.04 No joints shall be made in the conductor after it has been stranded.

10.02.00 **CONDUCTOR SCREEN**: The conductor screen shall be provided over the conductor consisting of extruded non metallic semi conducting compound.

10.03.00 **INSULATION**: The insulation shall be provided over the screened conductor with cross linked polyethylene, applied by extrusion and shall be of high quality, cross linked, shall be conforming to IS:7098 (part-2).

10.03.01 **THICKNESS OF INSULATION**: The average thickness of XLPE insulation shall not be less than the nominal value subject to the applicable tolerance as specified in table 2 of IS: 7098.

10.03.02 The insulation shall be applied to closely fit on the conductor screen, and it shall be possible to remove it without damaging the conductor.

10.03.03 The thickness of semi conducting screen over insulation should not be included in the thickness of Insulation.

10.04.00 **INSULATION SCREENING:** The Insulation screen shall be applied over the Insulations.

10.04.01 The Non-Metallic part of the Insulation screen shall consist of extruded Semi conducting compound.

10.04.02 The metallic part of the insulation screen shall consist of non-magnetic material, consisting of copper tape or tapes, and shall be applied over the non-metallic part. The metallic tape(s) shall be designed to carry the rated short circuit current.

10.05.00 **LAYING UP OF CORES:** For multi-core cables, the cores shall be laid together with a suitable right hand lay. The interstices at the centre shall be filled with a non-hygroscopic material.

10.06.00 **INNER-SHEATH FOR MULTI CORE CABLES:**

10.06.01 The cores shall be laid up with a suitable right hand lay and the interstices should be filled with PVC compound type ST2 conforming to IS:5831 or equivalent standard. The filling up of interstices shall be by pressure extrusion and this circular shape and shall bind the cores also.

10.06.02 The minimum thickness of the inner sheath shall conform to Table 3 of IS: 7098 (Part-2), 1985 or equivalent standard.

10.06.03 The inner-sheath shall be so applied that it fits closely on the laid up cores and it shall be possible to remove it without damage to the insulation cables.

10.07.00 **ARMOURING FOR 3 CORE CABLES:**

10.07.01 **Application**: The armour consisting of Galvanised steel wire shall be applied over the inner sheath for multi core cables.

10.07.02 The armour wires shall be applied as closely as possible.

10.07.03 The diameter of the galvanised round steel and hard drawn aluminium wires shall conform to IS: 7098 Part (2).

10.07.04 A binder tape may be applied on the armour.

10.07.05 The Joints in the armour wires shall be brazed/welded with joint surface and rendered smooth. The joints shall be staggered by at least 300 mm from the nearest joint in any other armour wire in the completed cable.

10.08.00 **OUTER SHEATH:**

10.08.01 The PVC outer sheath with anti termite treatment shall be extruded over the armouring for 3 core cables.

10.08.02 The colour of the outer sheath shall be black.

10.08.03 The thickness of outer sheath shall be not less than the minimum value specified in column 5 of Table 5 of IS: 7098 (Part-2) 1985.

10.09.00 **IDENTIFICATION:** The outer-sheath shall have the following information embossed or indented on it, the manufacturer's name or trade mark, the voltage grade, the year of manufacture and the letters "BESCOM". The identification shall repeat every 300/350 mm along with length of the cable.

11.00.00 **INSPECTION**:

11.01.00 Quality Control: The Bidder shall furnish a complete and detailed quality plan for the manufacturing process of the cable. All raw materials shall conform to relevant applicable standards and tested for compliance to quality and requirement.

During the manufacturing process, at all stages, inspections shall be made to check the physical and dimensional parameters, for verification to compliance to the standards.

11.02.00 The Bidder shall arrange, for inspection by the purchaser, during manufacture, if so desired by the purchaser, to verify the quality control process of the Bidder.

12.00.00 **TYPE TESTS**:

Not withstanding, that type test have been conducted earlier, the successful bidder the each member of consortium shall conduct all type tests as per IS:7098 part (2), 1985 with upto date amendments or equivalent international standard at his cost at either CPRI or any other accredited national laboratory/testing house and materials offered for inspection. Only after approval of the test reports from the purchaser materials shall be offered for inspection.

12.01.00 All type tests, routine, acceptance test shall be conducted in the presence of the purchaser, representative.

12.02.00 The successful Bidder shall give 15 days advance notice for inspections, and witnessing of tests by the purchaser or his representative.

12.03.01 The following type tests will be conducted on the cable.

a) Test on conductor
b) Test on armour wires
c) Test for thickness of XLPE insulation and inner and outer sheaths
d) Physical test on XLPE insulation
e) Physical test for outer sheath
f) Partial discharge test
g) Bending test
h) Di electric power factor test
    (i) As a function of voltage
    (ii) As a function of temperature
i) Insulation resistance (Volume resistivity) test
j) Heating cycle test
k) Impulse withstand test
l) High voltage test
m) Flammability test

12.03.02 The following test shall be performed successively on the same test sample of completed cable, not less than 10 M in length between the test accessories.

a) Partial discharge test
b) Bending test followed by partial discharge test
c) Dielectric power factor as a function of voltage
d) Dielectric power factor as a function of temperature
e) Heating Cycle test, followed by dielectric power factor and function of voltage and partial discharge test.
f) Impulse withstand test

g) High voltage test.

12.04.00 **ACCEPTANCE TEST**:

12.04.01 The sampling plan for acceptance test shall be as per IS:7098 Part (2) 1985, Appendix 'A'.

12.04.02 The following shall constitute the acceptance test.

a) Tensile test for aluminium
b) Wrapping test for aluminium
c) Conductor resistance test
d) Test for thickness of insulation
e) Test for thickness of inner and outer sheath
f) Hot-set test for insulation
g) Tensile strength and elongation at break test for insulation and outer sheath
h) Partial discharge test (on full drum length)
i) High voltage test
j) Insulation resistance (volume resistivity) test.

12.05.00 **ROUTINE TEST**:

The following shall constitute routine tests:

a) Conductor resistance test
b) Partial discharge test on full drum length
c) High voltage test

13.00.00 **PACKING**:

13.01.01 The cables, as per specified delivery lengths, shall be securely wound/packed in non-returnable, well seasoned sturdy wooden drums, with strong reinforcements so as to withstand rough handling during transport by Rail, Road etc., The packing should withstand storage conditions in open yards. The cable drums shall conform to IS:10418-1982 or equivalent standard.

13.01.02 The drawing of cable drums with full detail shall be furnished, and got approved before dispatch.

13.02.00 **SEALING OF CABLE ENDS ON DRUMS**:

13.02.01 The Cable ends shall be sealed properly so that ingress of moisture is completely prevented.

13.02.02 The individual core endings shall be sealed effectively with water resistant compound applied over the core and provided with a heat shrinkable cap of sufficient length with adequate cushion space so

that the conductor does not puncture the cap in case of movement of the core during unwinding or laying. Before sealing, the semi conducting layer on the cores may be removed for about 2 mm at each end, to facilitate checking the insulation resistance from one end, without removing the sealing cap at the other end.

13.02.03 The three cores should have a over all heat shrinkable cap with adequate end clearance, and sufficient cushioning to prevent puncturing of the overall sealing cap due to stretching of the cores. The sealing cap shall have sufficient mechanical strength and shall prevent ingress of moisture into the cable.

13.02.04 **CABLE LENGTHS**: The cables shall be supplied in continuous lengths of 250/500 m in case of 3 core cables with a tolerance of ± 5% of drum length.

13.02.05 **QUANTITY TOLERANCE**: ±5% tolerance shall be allowed on the ordered quantity.

14.00.00 **MARKING**:

The packed a cable drum shall carry the following information, clearly painted or stenciled.

a) The letters "BESCOM"
b) Reference to Standard and ISI Mark
c) Manufacture's Name or trade mark
d) Type of Cable & Voltage grade
e) Number of cores
f) Nominal cores sectional area of conductor
g) Cable code
h) Length of cable on the drum
i) Direction of rotation
j) Gross weight
k) Country of Manufacture
l) Year of Manufacture
m) Purchase Order No. and Date
n) Address of consignee.

15.00.00 Cross sectional drawings of the cables giving dimensional details for each size of cable.

a) An illustrated literature on the cable giving technical information, on current ratings, cable constants, short circuit ratings, derating factors for different types of installation packing date weights and other relevant information.

SCHEDULE-I

Annexure: TS-1

Schedule of requirement of 3 core armoured, 1 core armoured, 6.35/11KV (E) aluminium conductor, XLPE UG Cables

Sl. No.	Cross sectional area of conductor (Sq.mm.)	Minimum current rating (Amps) in ground	Minimum short circuit rating (KA/1 Sec)	Delivery length per drum (+ 5%)
1	3 x 95	190	8.9	500 M
2	3 x 240	315	22.5	250 M
3	3 x 400	395	37.6	250 M

The approximate current ratings in column 3 are for the following standard installation conditions.

i)	Maximum conductor temperature for continuous operation	90 Deg. C.
ii)	Ambient air temperature	40 Deg. C.
iii)	Ground temperature	30 Deg. C.
iv)	Thermal resistivity of soil	150 Deg. C.
v)	Depth of laying	90 cm
vi)	Maximum conductor temperature at the end of short circuit	250 Deg. C.
vii)	Method of installation	Installed single directly buried in ground

SCHEDULE-II

Annexure: TS-2

For the information of Bidder the important extracts from the Indian Standard IS:7098 (Part 2) 1985; "Specification for cross linked polyethylene insulated PVC sheathed cables are furnished here for their reference and to supply for the XLPE Cables called for in the bid specification

TABLE-1:- PROPERTIES OF XLPE INSULATION

Sl. No.	Property	Requirement
1	Tensile Strength	12.5 N/Sq.mm. Min.
2	Elongation at break	200 percent, Min.
3	**Ageing in air over**: a) Treatment: Temperature Duration b) Tensile Strength Variation c) Elongation Variation	 135 ± 3 Deg. C 7 Days ± 25% Max. ± 25% Max.
4	**Hot Set**: a) Treatment: Temperature Time under load Mechanical stress b) Elongation under load c) Permanent Elongation (Set after cooling)	 200 ± 3 Deg. C 15 minutes 20 N/Sq.mm. 175% Max. 15% Max.
5	**Shrinkage**: a) Treatment: Temperature Duration b) Shrinkage	 130 ± 3 Deg. C 1 Hour 4% Max.
6	**Water absorption (gravimetric)**: a) Treatment: Temperature Duration b) Water absorbed	 85 ± 2 Deg. C 14 Days 1 Mg/Sq.mm. cm. Max.
7	**Volume resistivity**: a) At 27 Deg. C b) At 90 Deg. C	 1×10^{14} ohm-cm. Min. 1×10^{12} ohm-cm. Min.

TABLE-2:- NOMINAL THICKNESS OF INSULATION

Nominal Area of Conductor in Sq.mm.	Nominal thickness of insulation (ti) in mm. 6.35/11KV – 3 Core
95	3.6
240	3.6
400	3.6

1) Thickness of insulation: The average thickness of insulation shall not be less than the nominal value (ti) specified in Table-2.

2) Tolerance on thickness of insulation: The smallest of the measured values of thickness of insulation shall not fall below the nominal value (ti) specified in Table-2 by more than 0.1 mm + 0.1 ti.

TABLE-3:- THICKNESS OF INNER SHEATH (All dimensions in mm)

Calculated diameter over laid up cores (ref. IS 10462 Part 1, 1983) *		Thickness of inner sheath (Min.)
Over	Upto & including	
(1)	(2)	(3)
-	25	0.3
25	35	0.4
35	45	0.5
45	55	0.6
55	-	0.7

(*) Fictitious calculation method for determination, dimensions of protective coverings of cables: Part-I Electrometric and Thermoplastic Cables.

TABLE-4:- DIMENSIONS OF ARMOUR GALVANIZED STEEL ROUND WIRES AND STRIPS

NOTE: The dimensions of Galvanised steel wires or strips shall bc as specified in Table-4.

Calculated diameter for Armour (ref. IS 10462 Part 1, 1983) *		Nominal thickness of steel strip	Nominal diameter of Round wirc
Over	Upto & including		
1	2	3	4
a) For all diameter in excess of 13		0.8	Nil
-	13	-	1.40
13	25	0.8	1.60
25	40	0.8	2.00
40	55	1.4	2.50
55	70	1.4	3.15
70	-	1.4	4.00

Note: (a) and (b) indicate two methods of practice in the application of armouring.

* Fictitious calculation method for determination of dimensions of protective covering of cables: Part-I Electrometric & Thermoplastic Insulated Cables.

TABLE-5:- THICKNESS OF OUTER SHEATH (All dimensions in mm)

Calculated diameter under the outer sheath (ref. IS:10462 Part 1, 1983) *		Nominal thickness of steel strip		Minimum thickness of outer sheath for Armoured Cables
Over	Upto & including	Nominal (ts)	Minimum	
1	2	3	4	5
-	15	1.8	1.24	1.24
15	25	2.0	1.40	1.40
25	35	2.2	1.56	1.56
35	40	2.4	1.72	1.72
40	45	2.6	1.88	1.88
45	50	2.8	2.04	2.04
50	55	3.0	2.20	2.20
55	60	3.2	2.36	2.36
60	65	3.4	2.52	2.52
65	70	3.6	2.68	2.68
70	75	3.8	2.84	2.84
75	-	4.0	3.00	3.00

(*) Fictitious calculation method for determination of dimensions of protective covering of cables: Part-I Electrometric & Thermoplastic Insulated Cables.

Note:

Armoured Cables: The thickness of outer sheath shall be not less than the minimum value specified in column 5 of Table-5.

Extracts from IS:7098 (Part 2), 1985, on Tests on Cables:

i) Partial Discharge Test: The Partial discharge magnitude at test voltage equal to 1.5 Uo shall not exceed 20 PC.

ii) Bending Test: The diameter of test cylinder shall be (20D ±5) percent, where D is the overall diameter of the completed cable.

iii) Dielectric Power Factor Test:

a) Tan 'delta' as a function of voltage:

The measured value of tan 'delta' at Uo shall not exceed 0.004 and the increment of tan 'delta' between 0.5 Uo and 2 Uo shall not be more than 0.002.

b) Tan 'delta' as a function of temperature:

The measured value of tan 'delta' shall not exceed 0.004 at ambient temperature and 0.008 at 90 Deg. C.

iv) Heating Cycle (As per IS: 10810 Part 49):

After their cycle, the sample shall be subjected to dielectric power factor as a function of voltage and partial discharge test.

v) Impulse withstand test:

The impulse voltage level for cables of rated voltage 6.35/11KV is 75 KV. No breakdown of insulation shall occur during the test.

vi) High voltage test (As a type test/Acceptance test) for 6.35/11KV rated voltage cables:

The cable shall withstand without breakdown an A.C. Voltage equal to 3 Uo but not less than 17 KV (rms when applied to the sample between conductor and screen/metallic tape/armour, the voltage shall be gradually increased to the specified value and maintained for a period of 4 hours.

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BESCOM

TECHNICAL SPECIFICATIONS
FOR
L.T. PVC Insulated Single Core Aluminium Lead Wire (Multi Strand).

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Technical Specification for L.T. PVC Insulated Single Core Aluminium Lead Wire (Multi Strand).

1. The PVC Aluminium lead wire (multi strand) shall be of 1,100 volts grade and shall be single core. The cable shall be supplied in coils of 100 Mtrs. Length.

2. The lead wire (multi strand) shall be manufactured, tested and supplied as per IS-694 of 2010 with latest amendments if any.

3. The conductors shall be composed of Aluminium wires complying with IS-8130 of 1984 with latest amendments, if any. The conductor particulars shall be as noted below.

Note: The conductor shall satisfy the requirement of resistance as per IS-8130 and also the nominal cross section specified below:

Sl. no	Cable	Conductor	Weight of Aluminium in kgs/100m	Remarks
1.	50Sq. mm	19/1.83mm	14.40	Un Sheathed
2	70 Sq.mm	19/2.17mm	20.17	Un Sheathed
3	95 Sq mm	19/2.52mm	27.40	Un Sheathed
4	120 Sq mm	37/2.03mm	34.58	Un Sheathed
5	150 Sq mm	37/2.27mm	43.22	Un Sheathed
6	185.0 Sq .mm	37/2.52 mm	53.30	Un Sheathed
7	240.0 Sq .mm	37/2.85 mm	70.30	Un Sheathed

(The weights of Aluminium conductor given above are as per IEEMA circular)

4. The conductor shall be provided with PVC insulation applied by extrusion and the PVC compound shall be type 'A' of IS5831 of 1984 with latest amendments, if any and shall satisfy test requirements for PVC insulation stipulated in IS 5831.

5. The colour of the cable and sheath shall be Black.

6. **Packing & Marking**:

6.1 The Marking shall be as per IS: 694 of 2010 with the following details;

A **On the Lead Wire:**

i) Reference of Indian Standard IS 694;
ii) Manufacturer's name, Brand name or Trade-Mark;
iii) The letter **"BESCOM".**
iv) Year of manufacture
v) Type of cable and Voltage Grade;

vi) Nominal cross sectional area of conductor;
vii) Cable code;
viii) Colour of core;
ix) The word 'suitable for outdoor use' ;

The printing, indentation or embossing shall be done on the insulation. The distance between any two consecutive printings, indentations or embossing shall be not more than 1m.

B **<u>On the Drum/ Reel:</u>**

i) Length of the cable on the reel, drum or coil;
ii) Direction of rotation of drum (by means of arrow);
iii) Approximate Gross Weight in kgs;
iv) Year of manufacture;
v) Purchase Order reference and Date.

6.2 The packing of the cable reel or drum shall also be marked with the standard markings and BESCOM Purchase order reference.

7. Test Certificates:-

a) All the type test certificates on conductors, PVC insulation etc. stipulated in IS 694 of 2010 with latest Amendments, if any shall be submitted for approval.
b) In case of an order, all the acceptance tests stipulated in IS 694 shall be conducted in presence of BESCOM representative.
c) Routine tests shall be conducted and test reports in the form of test certificates signed by a responsible officer of the firm shall be submitted to this office for approval before dispatch of the material.

General Manager El,
Procurement, BESCOM

TECHNICAL SPECIFICATION FOR SPIRAL EARTH ELECTRODE

1.0 This specification is for Spiral/ Coil earthing for non current carrying parts of DP structures in a distribution system.

2.0 Design & Construction

2.1 The material used shall be No.8 SWG GI Wire or higher size closely wound 115 turns as per drawing SIC/MISC/001 and SIC/DL/004.

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BANGALORE ELECTRICITY SUPPLY COMPANY LIMITED

TECHNNICAL SPECIFICATION FOR GAPLESS METAL OXIDE DISTRIBUTION TYPE SURGE ARRESTERS WITH POLYMERIC HOUSING FOR USE IN 11KV SYSTEM

1.0 SCOPE

This specification covers design, manufacture testing and supply of gapless Metal Oxide Distribution type surge arresters with polymeric housing for use in the 11kV overhead distribution system, to protect electric power systems from expose to over voltages which might over stress the dielectric strength of equipment used. Over voltages can be caused by lightning strokes (lightning over voltages). Switching and circuit breaking (Switching over voltages) or certain load flow conditions (Temporary over voltages).

2.0 APPLICABLE STANDARDS

2.1 Standards

Following Indian/International standards, which shall mean latest revision, with amendments/changes adopted and published, unless specifically stated otherwise in the specification, shall be referred while accessing conformity of polymeric surge arresters with these specifications.

2.1.1 In the event of supply of polymeric surge arresters conforming to standards other than specified, the Bidder shall confirm in his bid the these standards are equivalent or better to those specified. In case of award, salient features of comparison between the standards proposed by the bidder and those specified in this document will be provided by the supplies to establish equivalence.

Sl. No.	Indian standard	Title	International Standard
1	IS 15086 part-4 2017	Polymeric surge arresters, Part -4: Surge arresters without gapes for A.C. Systems overhead lines above 1000V	IEC:60099-4 2014, Edition-3 or latest if exists
2		Polymeric surge arresters – 5 selection & application recommendations	IEC:6009-5 , 2013 or latest if exists
3		Polymer burning behavior	IEC:60707 & UL94
4	IS:13134	Guide for the selection of Polymeric surge arrestor with respect of to	IEC:60815

		polluted conditions	
5		Thermal Mechanical performance test and mechanical performance test on Polymeric surge arrestors	IEC:60575
6		Hydrophobicity Classification Guide	STRI guide:1.92/1
7		Radio interference characteristics of overhead power lines and high voltage equipment	CISPR:18-2 Part 2
8	IS:8263	Methods of RI Test of HV surge arresters	IEC:60437
9		Standards for surge arresters-composite – Distribution Dead – end Type	ANSI C29.13
10		Hot dip zinc coating on structural steel & other allied products	ISO:1459 ISO:1461
11	IS:2629	Recommended practice for Hot, Dip Galvanization for iron and steel	ISO:1461(E)
12	IS:6745	Determination of Weight of Zinc coating on Zinc coated iron and steel articles	ISO:1460
13	IS:3203	Methods of testing of local thickness of electroplated coatings	ISO:2178
14	IS:2633	Testing of Uniformity of coating of Zinc Coated articles	
15		Standard specification for glass Fiber standards	ASTM D 578-05
16		Standard test method for Compositional analysis by thermogravimetric.	ASTM E 1131-03
17	IS:4699	Specification for refined secondary Zinc	

3.0 Technical Description of Polymeric Surge arresters

3.1 Service condition

The polymeric surge arresters to be supplied shall be suitable for satisfactory continuous operation under conditions as specified below:

Maximum ambient temperature : 50°C
Minimum ambient temperature : -5° C
Relative humidity : 0 to 1005

3.2 System Parameters

The arresters must be able to operate under the system parameters mentioned in this specification:

Nominal voltage system kV(rms)	11kV
Frequency	50Hz

Grounding of neutral	Solidly
Temporary over voltage (Earth fault factor)	10.4kV rms for 10sec.
Highest system voltage kV(rms)	12kV
Short circuit levels	16kA
Equipment Insulation withstand level	75kV
Wet Power Frequency withstand voltage	38kV

3.3 Surge arresters requirements:

a) Mechanical requirements:

Creepage length	300mm(Min.)
Pull strength	1000N (Min.)
Cantilever load	75Nm(Min.)
Torsion	30Nm(Min.)

b) Electrical requirements:

Arrester Max. Continuous Operating voltage Uc	8kV rms
Arrester Rated voltage Ur	12kV rms, with distribution medium - DH class as per latest Edition
Arrester Class / Nominal discharge current	DL / In=10kA
Min repetitive charge transfer capability : Qrs	Minimum 0.4C
Max. Lightning Impulse residual voltage @ In	29kVp
Max. Steep Impulse residual voltage @ In	32kVp
Minimum Thermal Charge rating for two impulses	Qth : 1.1C
TOV values	1 secs : kV 10 Sec : kV 100 Sec : kV
Surge arrester housing Insulation withstand voltages i) Lightning Impulse (Dry) ii) Power Frequency (Wet)	As per IEC 60099-4 / IS 15086 Part-4 Standard
High current impulse withstand (4/10 micro second value) kA (peak)	100kA
Pressure relief current High current Low current	16kA , High & low currents as per IEC 60099-4 / IS 15086 Standards
Partial Discharge	≤ 10 pC
Pollution Condition	Heavy

Minimum Bending load (kgm) SSL SLL Terminal torque	 50kgf 25kgf 2.5kgm

3.3.1 The polymeric surge arresters shall be suitable for 3, 50Hz, effectively earthed 11kV O/H distribution system in a heavily polluted atmosphere.

3.3.2 Bidder must be an indigenous manufacture and supplier of polymeric surge arresters of rating 11kV or above OR must have developed proven in house technology and manufacturing process for polymeric surge arresters of above rating OR possess technical collaboration/association with a manufacture of polymeric surge arresters of rating 11kV or above. The Bidder shall furnish necessary evidence in support of the above along with the bid, which can be in the form of certification from the utilities concerned, or any other documents to the satisfaction of the owner.

3.3.3 Polymeric surge arresters shall have sheds with good self – cleaning properties, surge arresters shed profile, spacing, projection etc., and selection in respect of polluted conditions shall be generally in accordance with the recommendation of IEC-60815/IS:13134.

3.4 Dimensional Tolerance of polymeric surge arresters

The tolerance on all dimensions e.g. diameter, length and creepage distance shall be allowed as follows:

$\pm$ (0.04d + 1.5)mm when d<300 mm.

$\pm$ (0.025d + 6) mm when d>300 mm.

Where, d being the dimensions in millimeters for diameter, length or creepage distance as the case may be.

However, no negative tolerance shall be applicable to creepage distance.

3.5 Interchangeability

The surge arresters including the end filling connection shall be of standard design suitable for use with the hardware fittings of any make conforming to relevant IEC/IS standards.

3.6 Corona and RI Performance

All surface arresters shall be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The surge arresters and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not

generated any radio interference beyond specified limit under the operating conditions.

3.7 Maintenance

3.7.1 The surge arresters offered shall be suitable for use hot line maintenance technique so that usual hot line can be carried out with ease, speed and safety.

4.0 BASIC FEATURES:

4.1 Design and construction

Surge arresters having one or several non-linear metal oxide resistor with highly non-linear voltage – current characteristics, connected in series, but having no integrated series or parallel gaps.

The surge arresters shall be of cage design/ warp design

Cage: Using FRP rods which can be used as mechanical supporting part to accommodate the stack of MO elements. The Silicon rubber insulation is then moulded directly on to the MO elements without any internal gas volume left.

The MO elements is safely kept in place by the cage together with the high compressive force and they are embedded in to silicon rubber. Thus, the active part is almost protected from mechanical impact resulting in high transports safety.

Wrap design: The Mechanically supporting part of the housing is formed by a wrapped FRP using Prepeg glass rovings or pre-impregnated bands that are wound around the MO resistor stack and cured. The resulting wrap, surrounding the varistor stack, to have open "windows" moulded with silicone rubber for relieving the short circuit. Shall be void free construction.

Since, there is a direct contact of the MO elements with the polymer material in cage and wrap designs, heat produced by the MO elements is more easily dissipated through the housing into the environment. This increases thermal stability and follows utilize more than MO elements with respect to electrical stress.

4.1.1 Cage:

It shall be a glass –fiber reinforced epoxy resin rod of high strength (FRP rod). Glass fibers and resin shall be optimized in the FRP rod. Glass fibres shall be Boron free electricity corrosion resistant (ECR) glass fiber or boron free E-Glass and shall exhibit both high electrical

integrity and high resistance to acid corrosion. The matrix of the FRP rod shall be Hydrolysis resistant. The FRP rod shall be manufactured through pultrusion process. The FRP rod shall be void free.

4.1.2 Housing (Sheath)

The surge arrester with housing made of silicon Rubber (SR) material without air voids neither between the housing and the metal oxide resistors nor the housing itself. Arresters must have directly moulded, housing FRP rod shall be covered by a seamless sheath of a silicon rubber compound of thickness of 3mm minimum.

It should protect the FRP rod/ FRP tapes shall be covered against environmental influences, external pollution and humidity. It shall be extruded or directly molded on the core and shall have chemical bonding with the FRP rod. The strength of the bond shall be greater than the tearing strength of the polymer. Sheath material in the bulk as well as in the sealing/bonding area shall be free from voids.

4.1.3 Weather Sheds

The weather sheds made of silicon rubber shall be firmly bonded to the sheath, vulcanized to the sheath or molded as part of the sheath and shall be free from imperfections. The weather sheds should have silicon content of minimum 30% by weight. The strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer. The interface, if any, between sheds and sheath (Housing) shall be free from voids, and shall be resistant against UV- radiation as well as tracking.

Silicone Rubber (RTV – 2/LSR) shall have inherent burning behavior, shall pass the test of IEC 60707 and UL94 with the highest class Vo, i.e. self- extinction within 10 seconds without development of burning drops. The limiting oxygen index(LOI) is greater the 35% i.e. to continue burning after inflaming an oxygen content of more then 355 is required.

4.1.4 End Fittings

The End fittings transmit the mechanical load to the core. They shall be made of spheroidal graphite cast iron, malleable cast iron or forged steel or aluminium alloy. They shall be connected to the rod by means of a controlled compression technique. The gap between fitting and sheath shall be sealed by a flexible silicone rubber sealing performance between housing i.e. seamless sheath and metal connections. The sealing must be moisture proof. End fitting shall be of type to suitable

for vertical and horizontal mounting and should match all mechanical and electrical requirements specified for the arrester. Terminals shall be made of M10 bolts allow the connections of line and ground leads.

4.1.5 Disconnector

Disconnector withstand

When an arrester is fitted or associated with a disconnector, this device shall withstand, without operating, each of the following tests:

a. Test to verify the retitive charge transfer rating, Qrs (see clause 8.5.2 of IS 15086(part 4):2017).
b. Operating duty test with rated values of thermal charge rating, Qth (see clause 8.7.2 of IS 15086(part 4):2017).
c. Mechanical tests on agreement between manufacturer and user (see NOTES 1 and 2 8.9.4.1 of IS 15086(part 4):2017).

Disconnector operation

Three values of current according to clause 8.9.3 of IS 15086(part 4):2017.There shall be clear evidence of effective and permanent disconnection by the device.

5.0 Workmanship

5.1 All the materials shall be of latest design and conform to the best engineering practices adopted in the high voltage field. Bidders shall offer only such surge arrester as are guaranteed by them to be satisfactory and suitable for continued good service in power Distribution System.

5.2 The design, manufacturing process and material control at various stages shall be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish and elimination of sharp edges and corners.

5.3 The design of the surge arrester shall be such that stresses due to expansion and contraction in any part of the arrester shall not lead to deterioration.

5.4 The MO shall be sound and free of cracks and voids that may adversely affect the arrester.

5.5 Weather sheds shall be uniform in quality. They shall be clean, sound, and smooth and shall be from defects and excessive flashing at parting lines.

5.6 End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively sealed to prevent moisture ingress; effectiveness of sealing system must be supported by test documents. Al. surfaces of the metal parts shall be perfectly smooth without projecting points or irregularities, which may cause

corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.

5.7 All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 610gm/sq.m or 87mm thickness and shall be in accordance with the requirement of IS:4759. The zinc used for galvanizing shall be of purity 99.5% as per IS:4699. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfections such as flux, ash rust strains, bulky white deposits and blisters. The galvanized metal parts shall be guaranteed to withstand of least four successive dips each lasting for one(1) minute duration under the standard test. The galvanizing shall be carried out only after any machining.

6.0 Equipment Marking:

6.1 Each surge arresters unit shall be legibly and indelibly marked with the following details as per IEC- 60099-4, Latest Edition

(a) Month & Year of manufacture.
(b) Manufacturer's name/Trade mark, Model no and identification Serial No.
(c) Maximum Continuous operating voltage.
(d) Rated Voltage
(e) Nominal discharge current and class of arrester
(f) Repetitive Charge Transfer Capability in Columbs
(g) Pressure relief class : Type A or Type B, Rated short circuit current in kA rms
(h) Cantilever strength-SSL/SLL/Terminal torque
(i) Total leakage and resistive leakage current-Ir at MCOV value .(before installation)
(j) Purchase order reference

6.2 Each ZnO element's Aluminum sprayed surface shall be printed with information like:

a. Batch No.
b. Designation with thermal energy and charge transfer rate
c. Rating & MCOV
d. Nominal Discharge current
e. AC reference voltage measured at reference current
f. Residual voltage measured at nominal discharge current
g. Type of the block (design code given by manufacturer)
h. Manufacturer's name

The manufacturers may use QR code printed on the block in case of size limitation.

7.0 Bid Drawing

7.1 The Bidder shall furnish full description and illustration of the material offered.

7.2 The Bidder shall furnish along with the bid the outline drawing (3 copies) of arrester unit including a cross sectional view.

7.3 After placement of award, the supplier shall submit full dimensioned manufacturing arrester drawings containing all the details in four (4) copies to the owner for approval. After getting approval from owner and successful completion of all the type tests, the supplier shall submit 10 more copies of the drawing to the Owner for further distribution and field use.

7.4 After placement of award the supplier shall also submit fully dimensioned arrester crate drawing for different type of surge arresters, drawing (cross sectional view) of ZnO elements used inside arrester for approval of the owner.

The drawings shall be submitted with the following details:

For the arrester:

a) Manufacturer name
b) Class and model no of arrester
c) Rated and MCOV of arrester
d) Nominal discharge current
e) Pressure relief type and current (High current and low current)
f) Thermal energy rating: W_{th}
g) Repetitive Charge Transfer rating: Q_{rs}.

For the ZnO element:

a. Batch No.
b. Designation with thermal energy and charge transfer rate
c. Rating & MCOV
d. Nominal Discharge current
e. AC reference voltage measured at reference current
f. Residual voltage measured at nominal discharge current
g. Power loss value measured at continuous operating voltage
h. Type of the block (design code given by manufacturer)
i. Manufacturer's name

8.0 Tests and Standards

Polymeric surge arrester offered shall be manufactured with the same configuration and raw materials as used in the Surge arrester for which design and type test reports are submitted. The manufacturer shall submit a certificate for the same. The design & type test reports submitted shall not be more than 5 years old.

8.1 Design Tests

Manufacture should submit test reports for design Tests as per relevant clauses of IEC-60099-4 / IS15086 Part-4 Latest Editions & IEC – 60099-5 / IS 15086 Part-5 latest Editions Standards along with the bid. Additionally following tests shall be carried out or reports for the tests shall be submitted after award of contract:

UV test: The test shall be carried out in line with clause 7.2 of ANSI IC29.13.

8.2 Type Tests

The following type tests shall be conducted on a suitable number of individual Surge arrester, components and materials.

8.2.1 The bidder shall submit type test reports as per IEC 60099-4 / IS along with the bid. Additional type tests as required above shall be carried out by the manufacturer after award of contract for which no additional charges shall be payable. In case the tests have already been carried out, the manufacturer shall reports for the same

Sl No.	Description of type test	Test procedure / Clause as per standards IEC 60099-4 / IS 15086 Latest Editions
1.	Residual Voltage Tests on elements • Steep Current Impulse residual voltage • Lightning Current Impulse 8/20 µS. • Switching impulse residual voltage test	8.3 / 10.8.3 8.3.2 / 10.8.3.2 8.3.3 / 10.8.3.3 8.3.4 / 10.8.3.4
2	Test to verify Long term thermal stability under continues operating voltage / Accelerated ageing test	8.4 / 10.8.4
3.	Repetitive charge transfer rate	8.5 / 10.8.5
4.	Heat Dissipation behavior of Test sample	8.6 / 10.8.6
5.	Operating duty test on prorated sections / Switching surge energy rating (IEEE)	8.7 / 10.8.7
6.	Power frequency vs time test / TOV test	8.8 / 10.8.8
7	Repetitive charge transfer test on Disconnectors	8.9.2/ 10.8.9.2
8	Operating duty test on Disconnectors	8.9.2 / 10.8.9.2
9	Disconnector Operation Tests	8.9.3/ 10.8.9.3
10	Short circuit test	8.10 / 10.8.10
11.	Bending moment test	8.11 / 10.8.11

12	Environmental test on arresters	8.12 / 10.8.12
13	Weather ageing test on polymer arresters	10.8.17
14.	Tests for arrestor disconnectors	Clause 4.1.5 of Technical specifications

8.2.2 It shall be the option of the owner to accept the surge arresters based on type test reports submitted by the manufacturer. The owner shall be free to repeat the type tests & may witness the same.
For the purpose of facilitating the type test, the bidders may quote test charges separately.

8.2.3 All the type test given in Clause No:8.2 in addition to routine and acceptance test shall be carried out on surge arresters along with hard ware fittings wherever required.

8.3 Acceptance (Sample) Tests

8.3.1 For Surge Arrester

a)	Measurement of Power Frequency voltage at Reference Current	Clause 9.2.1 As per IEC:60099-4 IEC:2014
b)	Lightning impulse residual on the complete arrester	
C)	Internal partial discharge test	
d)	Repetitive charge transfer rate with minimum Qrs = 0.4 C	

8.4 Routine Tests

A)	Measurement of reference voltage (Uref) (See 3.35 and 6.2)	Clause 9.1 As per IEC:60099-4 IEC:2014
b)	Residual voltage test	
c)	Internal partial discharge test	
d)	Current distribution test for multi-column arrester	
e)	For arrester units with sealed housing, a leakage check shall be made on each unit by any sensitive method adopted by the manufacture.	

8.5 Tests During Manufacture

Following tests shall be also be carried out on all components if applicable.

a)	Chemical analysis of zinc used for galvanizing
b)	Chemical analysis, mechanical, metallographic test and magnetic particle inspection for malleable castings.
c)	Chemical analysis, hardness tests and magnetic particle inspection for forgings

8.6 Sample batch for Type Testing

8.6.1 The bidder shall offer material for sample selection for type testing only after getting Quality Assurance Programme approved by the Owner. The bidder shall offer at least three times the quantity of materials required for conducting all the type tests for sample selection. The sample for type testing will be manufactured strictly in accordance with the Quality Assurance Programme approved by the Owner.

8.7 Additional Tests

8.7.1 The Owner reserves the right at his own expenses, for carrying out any other test(s) of reasonable nature carried out at supplies premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the material comply with the specifications.

8.7.2 The Owner also reserves the right to conduct all the tests mentioned in this specification at his own expense on the samples drawn from the site at supplies premises or at any other test center. In case of evidence of non compliance, it shall be binding on the part of the supplier to prove the compliance of the items to the technical specifications by repeat tests or correction of deficiencies or replacement of defective items, all without any extra cost to the owner.

8.8 co-ordination For Testing

8.8.1 The supplies shall have to co-ordinate testing of surge arresters with hard ware fittings to be supplied by other supplier and shall have to guarantee overall satisfactory performance of the surge arresters with the hardware fittings.

8.8.2 The bidder shall intimate the owner about carrying out of the type tests along with detailed testing programme at least 3 weeks in advance of the scheduled date of testing which the owner will arrange to depute his representative to be present at the time of carrying out the tests

8.9 Quality Assurance Plan

8.9.1 The successful bidder shall submit following information to the owner:

8.9.1.1 Test certificates of the raw materials and brought out accessories

8.9.1.2 Statement giving list of important raw materials, their grades along with manes of sub – supplies for raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of bidders representative.

8.9.1.3 List of manufacturing facilities available along with Routine test facilities.

8.9.1.4 Level of automation achieved and lists of areas where manual processing exists.

8.9.1.5 Lists of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

8.9.1.6 List of testing equipments available with the bidder for final testing of equipments along with valid calibration reports.

8.9.1.7 The manufacture shall submit manufacturing quality plan(MPQ) for approval & the same shall be followed during manufacture and testing,

8.9.2 The successful bidder shall submit the routine test certificates of brought out raw material/accessories and central excise passes fior raw material at the time of inspection.

8.10 Guarantee

The Supplier of surge arresters shall guarantee overall satisfactory performance of the surge arresters.

8.11.1 At least three copies of type test reports shall be furnished. One copy shall be returned duly certified by the owner. Only after which the commercial production of the concerned material shall start.

8.11.2 Copies of acceptance test reports shall be furnished in at least three(3) copies. One copy shall be returned duly certified by the owner, only after which the materials shall be dispatched.

811.3 Record of the acceptance test reports shall be maintained by the supplier. These shall be produced for verification as and when desired by the owner.

811.4 Test certificates of test during manufacture shall be maintained by the supplier. These shall be produced for verification as and when desired by the owner.

9.0 Inspection

9.1 The Owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where surge arresters and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the supplier's and sub-supplier's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.

9.2 The material for final inspection shall be offered by the supplier only under packed condition. The Owner shall select samples at random from the packed lot for carrying out acceptance tests. The lot offered for

inspection shall be homogenous and shall contain surge arresters manufactured in 3-4 consecutive weeks.

9.3 The supplier shall keep the owner informed in advance of the time of starting and the progress of manufacture of material in their various stages so that arrangements could be made for inspection.

9.4 No material shall be dispatched from its point manufacture before it has been satisfactory inspected and tested unless the inspection is waived off by the owner in writing. In the later case also material shall be dispatched only after satisfactory testing specified here in has been completed.

9.5 The acceptance of any quantity of material shall in way relieve the supplier of his responsibility for meeting all the requirements of the specification and shall not prevent subsequent rejection, if such materials are later found to be defective.

10.0 Packing

10.1 All surge arresters shall be packed in strong corrugated box of min.7 ply duly palette or wooden crates. The gross weight of the crates along with the material shall not normally exceed 100kg to avoid handling problem. The crates shall be suitable for outdoor storage under wet climate during rainy season.

10.2 The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.

10.3 Suitable cushioning protective padding or dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.

10.4 All Packing cases shall be marked legibly and correctly so as ensure safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty or illegible markings. Each wooden case/crate/corrugated box shall have all markings stencilled on it in indelible ink.

10.5 The bidders shall provide instructions regarding handling and storage precautions to be taken at site.

Tests on surge arresters units

1. **RIV Test (Dry)**

   The surge arresters string along with complete hardware fittings have a radio interference voltage level below 100 microvolts at one MHZ when subjected to 50 Hz AC voltage of 10kv class surge arresters under dry condition. The test procedure shall be in accordance with

IS:8263/IEC:437/CISPR 18-2. This test is applicable for surge arresters > 72.5kV

2. **Brittle Fracture Resistance Test**

Brittle fracture test shall be carried out on naked rod along with end fittings by applying "IN HNO3 acid" (63 g conc. HNO3 added to 937 g water) to the rod. The rod should be held at 80% of SML for the duration of the test. The rod should not fail within the 96 hour test duration. Test arrangement should ensure continuous wetting of the rod with Nitric acid.

3. **Recovery of Hydrophobicity & Corona test.**

The test shall be carried out on 4mm thick samples of 5cm x 7cm.

i) The surface of selected samples shall be cleaned with isopropyl alcohol. Allow the surface to dry and spray with water. Record the Hydrophobicity classification in line with STRI guide for Hydrophobicity classification. Dry the sample surface.

ii) The samples shall subjected to mechanical stress by bending the sample over a ground clectrodc. Corona is continuously generated by applying 12kv to a needle like electrode place 1mm above the sample surface. The test shall be done for 100 hrs.

iii) Immediately after the corona treatment, spray the surface with water and record the HC classification. Dry the surface and repeat the corona treatment as at clause 2 above. Note HC classification. Repeat the cycle for 1000 hrs or unit HC of 6 or7 obtained. Dry the sample surface.

iv) Allow the sample to recover and repeat hydrophobicity measurement at several time intervals. Silicone rubber should recover to IIC1 -- IIC 2 within 24 hours, depending on the material and the intensity of the corona treatment.

4. **Chemical composition test for Silicon content.**

The content of silicon in the composite polymer shall be evaluated by EDX (energy Dispersion X-ray) Analysis or Thermogravimetric analysis. The test may be carried out at CPRI or any other NABL accredited laboratory.

Annexure - B

Guaranteed technical Particulars of surge arresters

Name of the manufacture:

Address of works:

Sl.no	Description	Unit	
1.	Arrester Type or Designation	Kvrms	
2.	Arrester continuous operating voltage Uc	Kvrms	
3.	Arrester rated voltage Ur	KA	
4.	Nominal discharge current in	KA	
5.	Arrester Class	DH/DM/DL	
6.	High current discharge current 4/10us	KA	
7.	Repetitive Charge Transfer ratc	C	
8.	Repetitive Charge Transfer rate duration	µs	
9	Temporary overvoltage capability (kV rms)	0.1 sec 1.0 sec 10 sec 100 sec	
10.	Rated short circuit current Isc		
	a. pressure relief class		
	b. High current	kA	
	c. Low current	A	
11.	Pull strength	N	
12.	Cantilever strength	Nm	
13.	Torque strength	Nm	
14.	Total height of arrester	mm	
15.	Creepage length	mm	
16.	Flashover distance	mm	
17.	Housing Lightning impulse 1,2/50 Us withstand level	kVp	
18.	Housing Wet power frequency withstand level	kVrms	

19.	Housing type		
20.	Housing material		
21.	Colour of Housing		
22.	Void – free Design (state)	Yes/No	
23.	Bonding/Interfacial sealing(State)	Yes/No	
24.	Reference current	mA	
25.	Reference Voltage range(Min/Max)	kV	
26.	Max. partial discharge level	pC.	
27.	TOV curve enclosed?	Yes/No	
28.	Arrester will be able to operate under the system parameters mentioned is S3	Yes/No	
29.	Maximum residual voltage of arrester for: Lightning current impulse 8/20us at 5kA 10kA 20kA Step lightning current impulse 1/10 us at nominal discharge current In	kV	
30.	Minimum recommended centre to centre distance between arresters	mm	
31.	Minimum recommended distance from centre of arrester to nearest grounded object.	mm	
32	Each ZnO block Dimension		
32	Date of last Type test		

Date:

Place:

Signature

(Name)

(Designation)

(296)

TECHNICAL SPECIFICATION FOR RABBIT ACSR CONDUCTOR

1.0 SCOPE:

This specification covers manufacture, testing at manufacturer's works and supply of Rabbit ACSR conductor.

2.0 The basic technical and other particulars of the equipment and the various components are specified in the following sections and tender schedule.

3.0 CONSTRUCTION:

3.1 ACSR Conductor: The conductor shall comply in all respects with the latest edition of IS-398 (Part-II) 1996 with its latest amendment. The Aluminium wires used in the manufacture of the conductor shall be of the highest electrical quality and free from scratches, die marks and other surface imperfections. They shall be reinforced with a central core of galvanized high tensile steel wire having negligible sulphur and phosphorous contents.

3.2 The steel wire shall not be subject to any heat treatment after being galvanized. The zinc coating of steel wires shall be smooth and of uniform thickness. There shall be no bare spots owing to adherence of scales or other causes.

3.3 Joints in wires: Joints in the individual Aluminium, wires are permitted but no two such joints shall be within 15 meters apart in the complete stranded conductors. There should be no joints in the galvanized steel wire except those made in the base rod or wire before final drawing forming the core of steel reinforced Aluminium.

3.4 The resistance of the individual Aluminium wire shall be determined separately before stranding by means of standard tests on sample wires. The test samples shall be of sufficient length to give an accuracy of atleast one part in a thousand.